



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

RAMOS et al.

Atty. Ref.: 2764-34

Serial No. 09/725,165

TC/A.U.: 1764

Filed: November 29, 2000

Examiner: Leung, J.

For: SEALING SYSTEM FOR CYCLONE LEG

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March 16, 2006

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Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**APPEAL BRIEF**

Sir:

Applicants submit herewith their Brief on Appeal pursuant to 37 CFR §41.37.

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Void date: 03/17/2006 SZEWDIE1  
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**(I) REAL PARTY IN INTEREST**

The real party in interest is the Assignee, Petroleo Brasileiro S.A. - PETROBRAS,  
a Brazilian Company.

**(II) RELATED APPEALS AND INTERFERENCES**

On information and belief there are no other prior or pending appeals, interferences, or judicial proceedings (past or present), known to appellant, the appellant's legal representative, or assignee, which may be related to, directly affect or be directly affected by, or have a bearing on the Board's decision in this appeal.

### **(III) STATUS OF CLAIMS**

Claims 1 and 3-6 remain pending. Claim 2 has been canceled. Claims 1 and 3-6 have been rejected. The rejection of claims 1 and 3-6 is being appealed. A current listing of all pending claims is presented in the Claims Appendix of this Brief.

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**(IV) STATUS OF AMENDMENTS**

No amendment was filed subsequent to the rejection of June 22, 2005.

**(V) SUMMARY OF CLAIMED SUBJECT MATTER**

The present invention is directed to a termination and sealing system for two-stage legs of in-series cyclones used for separating out solids in gas-solid suspension in fluid catalytic cracking (FCC) processes. More specifically, the claimed invention provides a termination system which joins the lower end of the leg of a secondary cyclone and the leg of a primary cyclone, forming a single primary and secondary cyclone leg complex where the solids collected by both stages of cyclones are combined and these combined solids are simultaneously discharged by means of a single leg termination that is radius-curved and devoid of movable sealing parts. The termination configuration allows improved, efficient sealing in such a manner as to prevent the re-entrainment of particulates, and to reduce or eliminate the risk of "packing-down" of the dense bed of particles collected in the cyclones. It also avoids the mechanical failure which may arise in movable sealing systems, since flapper or trickle valves are eliminated. The result of its use is a substantial increase in efficiency and a consequent reduction of particulate emission.

Thus, and more specifically, the invention provides a termination system for joining and sealing the lower end of the leg 24 of a secondary cyclone 22 and the leg 23 of a primary cyclone 21, comprising a cyclone separator leg 26 which joins the lower end of the leg 24 of the secondary cyclone 22 and the leg 23 of the primary cyclone 21 to form a single primary and secondary cyclone leg complex where solids collected by both cyclones are combined, said separator leg terminating distally in a radius-curved single leg termination that is immersed in a fluidized bed 9 of particles and devoid of movable sealing parts (page 6, lines 10-19), wherein said collected and combined solids are discharged from said separator leg through said radius-curved single leg termination.

In an example embodiment, the radius-curve of the single leg termination has a ratio of radius/diameter within the range from 1.0 to 3.0 (page 6, lines 19-20).

In an example embodiment, the radius-curved single leg termination is constructed from a succession of straight tube sections 32 in an arcuate array (page 6, lines 20-21).

In an example embodiment, the succession of straight tube sections of the radius-curve direct a descending mass flow of dense phase solids into a plane orthogonal to an ascending gaseous flow (page 6, lines 25-27).

Further, in an example embodiment, with respect to the centre line of an inlet to the radius-curved single leg termination 31, a junction 25 of the leg of the primary cyclone 21 and the leg of the secondary cyclone 22 lies on the side opposite a distal end of the radius-curved termination 31 and higher than the distal end by a distance in the range from 3.5 to 5.5 times a diameter of the leg 23 of the primary cyclone 21 (page 7, lines 9-14).



**(VI) GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

Claim 1 stands rejected under 35 USC §102(b) as being anticipated by Jones '191.

Claim 3 stands rejected under 35 USC §103(a) as being unpatentable over Jones '191 in view of Danielsen et al.

Claims 4 and 5 stand rejected under 35 USC §103(a) as being unpatentable over Jones '191 in view of Luckenbach.

Claim 6 stands rejected under 35 USC §103(a) as being unpatentable over Jones '191.

Claims 1 and 6 stand rejected under 35 USC §103(a) as being unpatentable over Williams et al. in view of Jones '191.

Claim 3 stands rejected under 35 USC §103(a) as being unpatentable over Williams et al. in view of Jones '191 and further in view of Danielsen.

Claims 4 and 5 stand rejected under 35 USC §103(a) as being unpatentable over Williams et al. in view of Jones '191 and further in view of Luckenbach.

**(VII)      ARGUMENT**

A.      Background

The invention is directed to improving the collecting efficiency of the cyclone's second stage, without using moving parts in its termination, as is traditionally practiced.

For the cyclone's first stage leg where a high load of solids exists, it is the usual practice not to use terminations with moving parts (these terminations being plunged in the solids fluidized bed), since the high throughput of solids along them, together with an appropriate geometrical conformation at the leg termination, enables the first stage of the cyclone to be operated at a high collection efficiency.

Conventionally the cyclone's second stage, because it has a extremely low throughput of solids, requires a termination with moving parts (a valve of the movable lid type), otherwise the collecting efficiency is lowered due to the entry into the leg of gases from the fluidized bed. This termination with moving parts in the leg of the cyclone second stage is subject to frequent failures, besides having a low efficiency as to the sealing against gas entry, even when operating at normal conditions.

It was in order to overcome the sealing problems of the cyclone second stage leg termination that the applicant proposed a single leg formed downstream of a junction of the first- and second-stage cyclones. This single leg possesses a termination in the shape of a curve, which is immersed in the catalyst fluidized bed and devoid of moving parts. Because of the high throughput, the possibility of gas flowing back into the leg is reduced to a minimum. Moreover, as there are no moving parts subject to failure, the collection efficiency for the set of cyclones is kept high and constant along all the run.

B. Claim 1 is patentable as not having been anticipated by Jones '191.

In section 10 of the Examiner's July 19, 2005 Official Action, the Examiner reproduces claim 1 with certain of the terms in bold and a part of the preamble in italics. The Examiner advises that only the elements presented in bold have been given patentable weight and that the italicized recitation has been ignored because it appears in the preamble. Applicant respectfully challenges the Examiner's decision to consider only certain of the elements of applicant's independent claim 1 while ignoring other elements and limitations. While it is recognized that in certain circumstances the preamble may be considered only to recite "intended use", it is respectfully submitted that such an analysis is improper with respect to claim 1 as presented by applicant. In this regard, contrary to the Examiner's convenient disregard of numerous limitations of claim 1, it is respectfully submitted that because the italicized features of the preamble are specifically referenced again the body of the claim, they constitute structural and functional limitations of the recited termination system that cannot be unilaterally and summarily disregarded by the Examiner. Indeed, the claimed termination system specifically requires that the "cyclone separator leg" join the lower end of the leg of a secondary cyclone and the leg of a primary cyclone (series cyclones, not parallel cyclones) to form a single primary and secondary cyclone leg complex where the solids collected by both cyclones are combined. Thus, the separator leg is structurally defined as joining the legs of the secondary cyclone and the primary cyclone to form a complex where the solids are combined. The Examiner cannot, under the guise of "intended use" disregard the aforementioned specific limitations of applicant's claim 1.

It is also improper for the Examiner to completely disregard the "wherein" clause at the end of applicant's claim and the provision that the termination is adapted to be immersed in a fluidized bed. In this regard, the C.C.P.A. addressed the issue of functional language limiting the claimed structure. In In re Venezia, 189 U.S.P.Q. 149 (C.C.P.A. 1976), the C.C.P.A. stated that the claimed invention included structural

limitations on each part and those structural limitations were defined by how the parts are to be interconnected in the final assembly. Id. at 151. The court stated that the terms "adapted to be affixed" or "when said housing is in its repositioned location", for example, define present structures or attributes of the parts identified, which limit that structure. The court further stated that there is nothing wrong in defining structures of the components of the completed assembly in terms of the interrelationship of the components, or the attributes they must possess. Id. at 152.

Furthermore, in Pac-Tec Inc. v. Amerace Corp., 14 U.S.P.Q. 2d 1871 (Fed. Cir. 1990), the C.A.F.C. affirmed the district court's finding that when considering the claims as wholes, functional language, such as "adapted to" and "thereby", constitutes structural limitations, citing In re Venezia, and that functional language cannot be disregarded in such cases. Pac-Tec Inc. v. Amerace Corp., at 1876.

Thus, it is respectfully submitted that the Examiner has improperly disregarded specific limitations of applicant's independent claim 1. It is further respectfully submitted that contrary to the Examiner's characterization of the noted limitations, they are not merely a recitation of intended use but provide details of the structural configuration of the claimed termination system that must be given patentable weight. It is further respectfully submitted that Jones is not capable of performing the claimed "intended use" because there is no structural teaching in Jones or Jones description of the prior art, of a separator leg that joins and seals the lower end of the leg of a secondary cyclone and the leg of a primary cyclone.

The Examiner cites column 1, lines 32-48 of Jones as allegedly teaching multiple cyclones discharging solids into a common dipleg. It is respectfully noted that the cited passage in Jones is a general description of the prior art; Jones does not illustrate that assembly nor describe incorporating select characteristics of Jones's structure in it or vice versa. Furthermore, to the extent this passage of Jones may be construed to teach

multiple cyclones discharging solids into a common dipleg, it is respectfully submitted that describes only the joining of diplegs of the same stage (parallel cyclones). As such, it is respectfully submitted that Jones does not teach or suggest the combination claimed, including joining diplegs of different stages. Furthermore, the fact that Jones acknowledges that there are prior art installations where multiple cyclones discharge solids to a common dipleg does not mean *ipso facto* that Jones is advocating the provision of a radius curve at the termination of a separator leg which joins two diplegs. On the contrary, there appears to be two discrete teachings in Jones and no teaching of the combination advanced by the Examiner. Thus, Jones may teach that there are known installations where plural cyclones of a given stage discharge into a common dipleg, but it is in an entirely separate context that Jones discloses a curved dipleg end having a mechanical closure that is selectively released. Even if the Examiner construes Jones as allegedly teaching that his curved dipleg end could be provided as a common dipleg into which plural cyclones discharge (based on the prior art description in column 1), Jones still does not anticipate joining diplegs of different stages because, as noted above, the prior art Jones describes joins diplegs from the same stage.

Thus, Jones does not anticipate the combination claimed because Jones does not teach, in combination, a separator leg joining a leg of the secondary cyclone and the leg of a primary cyclone and wherein the separator leg terminates in a radius-curved separator leg termination. Indeed, as noted above, the discussion of joining diplegs in column 1 refers to diplegs of a single stage not joining diplegs of the primary and secondary stages, which is completely lacking in the applied art.

Furthermore, Jones does not teach such a combination devoid of movable sealing parts. Quite the contrary, Jones' invention specifically provides for a mechanical closure on the dipleg that is selectively released and, thus, expressly teaches a movable sealing part.

The Examiner asserts that Jones' sealing plate is only present when catalyst is introduced and is only temporary and will be removed during operation by the presence of a weight to pull a metal plate out of position or by forming the sealing means from a material that will partly or wholly fuse or rupture or disintegrate. However, the Examiner has by this admission acknowledged that Jones does teach a mechanical sealing part for the distal end of his dipleg and does teach that at least a part of the mechanical closure is movable. As such, Jones does not anticipate a distal termination that is devoid of movable sealing parts. Jones invention expressly provides for a mechanical closure placed on the dipleg and, thus, the invention is not anticipated. Indeed, it would be contrary to Jones invention to provide no sealing part. Therefore, claim 1 is not anticipated by nor obvious from Jones.

Even if the Examiner considers that Jones provides a dipleg that is devoid of movable sealing parts during at least one point in its operation and thus, at that time, allegedly structurally meets the "devoid of moving parts" limitation of claim 1, Jones nevertheless fails to teach or in any way suggest the joinder of the leg of a secondary cyclone and the leg of a primary cyclone so that the invention claimed would still not have been anticipated.

C. Claim 3 is patentable as not having been obvious over Jones '191 in view of Danielsen et al.

Claim 3 is submitted to be patentable from Jones for the reasons advanced above. The Examiner's further reliance on Danielsen does not overcome the deficiencies of Jones noted above. In fact, Danielsen also teaches away from the invention by providing a movable sealing part at the distal end of the leg structure.

Section 103 does not allow the Examiner to engage in picking and choosing from the prior art only to the extent that it will support a holding of obviousness, while

excluding parts of the prior art essential to the full appreciation of what the prior art suggests to one of ordinary skill in the art. In re Wesslau, 147 USPQ 391 (CCPA 1975).

It is therefore respectfully submitted that claim 3 is also allowable over the prior art of record.

D. Claims 4 and 5 is patentable as not having been obvious from Jones '191 in view of Luckenbach.

These claims are submitted to be patentable over Jones for the reasons advanced above. The Examiner's further reliance on Luckenbach does not overcome the deficiencies of Jones noted above. In fact, Luckenbach also teaches away from the claimed invention because Luckenbach discloses movable sealing parts in direct contradiction to the combination claimed in applicant's claim 1 and the claims dependent therefrom.

It is further respectfully submitted that Lukenbach does not teach or suggest that the radius curved portion of Jones could or should be formed from a plurality of straight pipe sections. In the case of Lukenbach, a single pipe part 14 is provided at an incline. Lukenbach does not teach that his inclined part is formed from a series of straight pipe sections; only a single pipe section is shown forming this component. Likewise, Lukenbach provides no teaching or suggest whatsoever regarding using straight pipe sections to form a radius curve. In fact, if Lukenbach's teachings were followed in Jones, then Jones would provide a single straight segment at an incline as depicted in Lukenbach, rather than the single curved pipe Jones discloses. It is therefore, respectfully submitted that any proper combination of Jones and Lukenbach would still not anticipate nor render obvious the plural straight portions applicant claims in claims 4 and 5.

It is further respectfully noted that claim 5 provides that the succession of straight tube sections directs the mass flow against phase particles into a plane orthogonal to the ascending gas flow. This is not true of Jones as Jones clearly directs mass flow at an acute angle to and in the same direction as the gas flow, as understood from Figure 2. Thus, Jones does not teach or suggest a curve directing mass flow in a plane orthogonal to the gas flow direction. Lukenbach also fails to teach or suggest directing flow in a direction orthogonal to the gas flow because Lukenbach teaches mass flow directed downwardly at an acute angle to and in the opposite direction from the gas flow. Thus, any proper combination of Jones and Luckenbach does not anticipate nor render obvious claim 5 either.

It is therefore respectfully submitted that claims 4 and 5 are also patentable over the prior art of record.

E. Claim 6 is patentable as not having been obvious from Jones '191.

The Examiner's suggestion that Jones is "silent" as to the vertical distance between the junction and the discharge end is not well taken. Jones is not just silent, but provides no teaching or suggestion whatsoever in this regard, in part because Jones provides no teaching relevant to a configuration wherein multiple cyclones (of different stages) are joined.

Furthermore, as noted above, Jones does not teach or suggest that his dipleg terminal end is properly adapted to cyclones in multiple. Rather, the reference to cyclones in multiple is just a general reference to one type of known cyclone assembly. Even if Jones' removable closure plate and curved tip were applied to a common dipleg, Jones provides no teaching whatsoever as to the position of the junction of the legs relative to the radius-curved termination. The Examiner's conclusion that it would "inherently" lie on the side opposite the junction of the primary and secondary cyclone



diplegs is pure conjecture on the Examiner's part. In this regard, it is noted that claim 1 provides that the lower end of the leg of the secondary cyclone (22 in the disclosed example embodiment) joins the leg of the primary cyclone (21). In Jones, cyclone 13 is the secondary cyclone and it terminates in the plate 19 sealed curved end 20. If the secondary cyclone leg 16 of Jones were joined to the primary cyclone leg 11, there would be no curved end at all or, if one was provided, it may well be directed towards the center line of the fluidized bed and, thus, would be on the same side of the combined leg as the juncture of the second cyclone leg and the first cyclone leg. Therefore, the Examiner's statement that the curved tip would inherently lie on the opposite side from the junction is not supported by the record.

The Examiner's suggestion that the location of the junction would be an obvious matter of design choice is also without any basis whatsoever in the record. Indeed, the Examiner has cited no teachings of multiple cyclone junctions other than the general references thereto in the primary reference and, thus, has cited no teaching relevant to the factors considered by a skilled artisan in deciding where such a junction should be provided. Applicants have specified a particular relationship between the junction and the outlet related to the diameter of the dipleg, which is nowhere anticipated nor suggested by the record prior art. In the absence of a motivation to modify the primary reference to produce the invention claimed, the invention can not be properly said to have been obvious.

It is clear that the initial burden of establishing a basis for denying patentability to a claimed invention rests upon the Examiner. In re Piasecki, 745 F. 2d 1468, 223 USPQ 785 (Fed. Cir. 1984). In establishing a *prima facie* case of obviousness under 35 U.S.C. § 103, it is incumbent upon the Examiner to provide a reason why one of ordinary skill in the art would have been led to arrive at the claimed invention from the prior art. Ex parte Clapp, 227 USPQ 972 (BPAI 1985). To this end, the requisite motivation must stem from some teaching, suggestion or inference in the prior art as a

whole or from the knowledge generally available to one of ordinary skill in the art and not from applicant's disclosure. See, for example, Uniroyal, Inc. v. Rudkin-Wiley Corp. 837 F.2d 1044, 7 USPQ 2d 1434 (Fed. Cir. 1988).

Rejections based on 35 USC §103 must rest on a factual basis with these facts being interpreted without hindsight reconstruction of the invention from the prior art. The Examiner has initial duty of supplying the factual basis for the rejection. The Examiner may not, because of doubt that the invention is patentable, resort to speculation, unfounded assumption or hindsight reconstruction to supply deficiencies in the factual basis. See In re Wanery, 379 F.2d 1011, 1017, 154 USPQ 173, 177-78 (CCPA 1967).

F. Claims 1 and 6 are patentable as not having been obvious from Williams et al in view of Jones '191.

The Examiner characterizes Williams as allegedly teaching a cyclone separator leg 41 which joins the lower end of the leg of a "secondary" cyclone 80 and the leg of a "primary" cyclone 40 to form a single cyclone leg complex where solids collected by both cyclones are combined. Applicant respectfully challenges the Examiner's characterization of Williams. Indeed, it is respectfully submitted that cyclone 80 and cyclone 40 are of the same stage and, therefore, do not comprise a respective primary cyclone and secondary cyclone as claimed by applicant. More specifically, according to Williams' disclosure, products of the cracking reaction pass upwardly through the dilute phase section of vessel 15, above the upper surface 36 of the catalyst bed, into cyclone separator 40 where entrained catalyst is separated from the vapors. The separated catalyst is returned to the fluidized bed of catalyst 35 through dipleg 41. Similarly, catalyst separated from the gases and vapors in cyclone separator 80 is returned to the fluidized bed of catalyst 35 through common dipleg 41. Gases and vapors from separator 80 are discharged through line 82 to plenum chamber 45 to line 46. Cyclone

separator 80, though represented diagrammatically as a single unit, may comprise an assembly of cyclone separators according to the Williams disclosure. The main point here, however, is that in Williams, the two stripper chambers 40 and 80 that have their diplegs joined are both "secondary". Thus, common dipleg 41 does not join cyclones of primary and secondary stages.

In the invention claimed in claim 1, the diplegs of two different stages are joined and the solids collected are combined. If the invention were implemented in Williams, by way of example, the dipleg of cyclone separator 40 or 80 (41) would be joined to either dipleg 37/76 or 38/78 which of course Williams does not contemplate nor in any way disclose to the skilled artisan. Indeed, one skilled in the art considering the Williams disclosure and/or the Jones disclosure would not be induced to join dipleg 41 to dipleg 76 or 78. There is no teaching whatsoever of such a structural configuration. Jones does not teach such a modification of Williams either, because the only mention of Jones of joiner of plural cyclones once again refers to joining cyclones of a single stage, which Williams already provides.

It is further respectfully submitted that Williams does not teach or suggest the feature of claim 1 that the cyclone separator leg terminates distally in a radiused/curved single leg termination immersed in a fluidized bed of particles and devoid of movable sealing parts. The dipleg 41 referenced by the Examiner is disclosed as having a straight terminus. The dipleg 76 and 78 are characterized as provided at its lower end with a "known J-seal illustrated". But known J-seals include movable mechanical parts.

Even if the terminus were changed to correspond to the terminus of Jones, for the reasons advanced above, even Jones teaches the provision of a sealing component that has been disabled or removed. It is therefore respectfully submitted that the terminus recited in applicant's claim 1 is not taught or suggested by Williams when taken alone or in combination with Jones. But again, even if such a terminus were

provided, as noted above, there would still be no teaching or suggestion of joining the diplegs of a primary cyclone and a secondary cyclone to provide a single cyclone separator leg combining the outputs of the two different stage cyclones in the combination claimed by applicant.

Regarding claim 6, the Examiner's suggestion that Williams is "silent" as to the vertical distance between the junction and the discharge end is not well taken. Williams is not just silent, but provides no teaching or suggestion whatsoever in this regard. Even if Jones' removable closure plate and curved tip were applied to dipleg 41, neither Williams nor Jones provides any teaching whatsoever as to the position of the junction of the legs relative to the radiused/curved termination. Thus, for the same reasons advanced above with respect to the Examiner's Section 103 rejection of claim 6 over Jones, it is submitted that claim 6 is patentable over Williams and Jones.

For all the reasons advanced above, it is respectfully submitted that claims 1 and 6 are not anticipated by nor obvious from Williams taken alone or in combination with Jones.

G. Claim 3 is patentable as not having been obvious from Williams et al in view of Jones '191 and further in view of Danielsen.

Claim 3 is submitted to be patentable over the Williams/Jones combination for the reasons advanced above. The Examiner's further reliance on Danielsen does not overcome the deficiencies of Jones noted above. In fact, Danielsen also teaches away from the invention by providing a movable sealing part at the distal end of the leg structure.

It is therefore respectfully submitted that claim 3 is also allowable over the applied prior art.

H. Claims 4 and 5 is patentable as not having been obvious from Williams et al in view of Jones '191 and further in view of Luckenbach.

These claims are submitted to be patentable over Jones for the reasons advanced above. The Examiner's further reliance on Luckenbach does not overcome the deficiencies of the Williams/Jones combination. In fact, Luckenbach also teaches away from the claimed invention because Luckenbach discloses movable sealing parts in direct contradiction to the combination claimed in applicant's claim 1 and the claims dependent therefrom.

It is further respectfully submitted that Lukenbach does not teach or suggest that the radius curved portion of Williams/Jones could or should be formed from a plurality of straight pipe sections. In the case of Lukenbach, a single pipe part 14 is provided at an incline. Lukenbach does not teach that his inclined part is formed from a series of straight pipe sections; only a single pipe section is shown forming this component. Likewise, Lukenbach provides no teaching or suggest whatsoever regarding using straight pipe sections to form a radius curve. In fact, if Lukenbach's teachings were followed in Williams, then Williams would provide a single straight segment at an incline as depicted in Lukenbach. It is therefore, respectfully submitted that any proper combination of Williams, Jones and Lukenbach would still not anticipate nor render obvious the plural straight portions applicant claims in claims 4 and 5.

It is further respectfully noted that claim 5 provides that the succession of straight tube sections directs the mass flow against phase particles into a plane orthogonal to the ascending gas flow. This is not true of Williams/Jones which clearly directs mass flow at an acute angle to and in the same direction as the gas flow. Thus, Williams/Jones does not teach or suggest a curve directing mass flow in a plane orthogonal to the gas flow direction. Lukenbach also fails to teach or suggest directing flow in a direction orthogonal to the gas flow because Lukenbach teaches mass flow

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directed downwardly at an acute angle to and in the opposite direction from the gas flow. Thus, any proper combination of Williams/Jones and Luckenbach does not anticipate nor render obvious claim 5 either.


It is therefore respectfully submitted that claims 4 and 5 are also patentable over the prior art of record.

### **CONCLUSION**

For all the reasons advanced above, reversal of the Examiner's Rejections and allowance of all pending claims is solicited.

Respectfully submitted,

**NIXON & VANDERHYE P.C.**

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**(VIII) CLAIMS APPENDIX**

1. (Previously presented) A termination system for joining and sealing the lower end of the leg of a secondary cyclone and the leg of a primary cyclone, comprising:

a cyclone separator leg which joins the lower end of the leg of the secondary cyclone and the leg of the primary cyclone to form a single primary and secondary cyclone leg complex where solids collected by both cyclones are combined, said separator leg terminating distally in a radius-curved single leg termination that is immersed in a fluidized bed of particles and devoid of movable sealing parts, wherein said collected and combined solids are discharged from said separator leg through said radius-curved single leg termination.

Claim 2. (canceled).

3. (Previously presented) A system according to claim 1, wherein the radius-curve of the single leg termination has a ratio of radius/diameter within the range from 1.0 to 3.0.

4. (Previously presented) A system according to claim 1, wherein said radius-curved single leg termination is constructed from a succession of straight tube sections in an arcuate array.

5. (Previously presented) A system according to claim 4, wherein the succession of straight tube sections of the radius-curve direct a descending mass flow of dense phase solids into a plane orthogonal to an ascending gaseous flow.

6. (Previously presented) A system according to claim 1, wherein, with respect

to the centre line of an inlet to the radius-curved single leg termination, a junction of the leg of the primary cyclone and the leg of the secondary cyclone lies on the side opposite a distal end of the radius-curved termination and higher than the distal end by a distance in the range from 3.5 to 5.5 times a diameter of the leg of the primary cyclone.



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**(IX) EVIDENCE APPENDIX**

No evidence has been submitted during prosecution of this application pursuant to 37 CFR §§1.130, 1.131, 1.132.

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**(X) RELATED PROCEEDINGS APPENDIX**

(NONE)